CHM129
Problem Set #1

① Molar Mass $PtCl_2(NH_3)_2$

Pt :	1 × 195.08 g/mol	=	195.08 g/mol
Cl :	2 × 35.45 g/mol	=	70.90 g/mol
N :	2 × 14.01 g/mol	=	28.02 g/mol
H :	6 × 1.01 g/mol	=	6.06 g/mol
			300.06 g/mol

$$\%Pt = \frac{(1)(195.08\ g/mol)}{300.06\ g/mol} \times 100 = 65.01\%$$

$$\%Cl = \frac{(2)(35.45\ g/mol)}{300.06\ g/mol} \times 100 = 23.63\%$$

$$\%N = \frac{(2)(14.01\ g/mol)}{300.06\ g/mol} \times 100 = 9.338\%$$

$$\%H = \frac{(6)(1.01\ g/mol)}{300.06\ g/mol} \times 100 = 2.02\%$$

② (a) $\_\_ N_{2(g)} + \underline{3}\ H_{2(g)} \longrightarrow \underline{2}\ NH_{3(g)}$ Combination

(b) $\_\_ Cu_{(s)} + \underline{2}\ AgNO_{3(aq)} \longrightarrow \underline{2}\ Ag_{(s)} + \_\_ Cu(NO_3)_{2(aq)}$

Single Displacement

(c) $\_\_ C_5H_6O_{(l)} + \underline{6}\ O_{2(g)} \longrightarrow \underline{5}\ CO_{2(g)} + \underline{3}\ H_2O_{(g)}$

Combustion

(3) (a) 1.0×10^{-2} mol NaCl $\left(\frac{58.44 \text{ g NaCl}}{1 \text{ mol NaCl}}\right) = 0.58 \text{ g NaCl}$

(b) 76.5 g TiO_2 $\left(\frac{1 \text{ mol } TiO_2}{79.87 \text{ g } TiO_2}\right) = 0.958 \text{ mol } TiO_2$

(c) 0.105 mol CO_2 $\left(\frac{6.022 \times 10^{23} \text{ } CO_2 \text{ molecules}}{1 \text{ mol } CO_2}\right) = 6.32 \times 10^{22}$ CO_2 molecules

(4) 55.8 g $Pb(NO_3)_2$ $\left(\frac{1 \text{ mol } Pb(NO_3)_2}{331.2 \text{ g } Pb(NO_3)_2}\right)\left(\frac{2 \text{ mol KI}}{1 \text{ mol } Pb(NO_3)_2}\right)\left(\frac{166.00 \text{ g KI}}{1 \text{ mol KI}}\right)$

$= 55.9 \text{ g KI}$

(5) Balance Equation: $2\ Mg_{(s)} + \_\_\ O_{2(g)} \longrightarrow 2\ MgO_{(s)}$

10.1 g Mg $\left(\frac{1 \text{ mol Mg}}{24.31 \text{ g Mg}}\right)\left(\frac{2 \text{ mol MgO}}{2 \text{ mol Mg}}\right)\left(\frac{40.31 \text{ g MgO}}{1 \text{ mol MgO}}\right) = 16.7 \text{ g MgO}$

10.5 g O_2 $\left(\frac{1 \text{ mol } O_2}{32.00 \text{ g } O_2}\right)\left(\frac{2 \text{ mol MgO}}{1 \text{ mol } O_2}\right)\left(\frac{40.31 \text{ g MgO}}{1 \text{ mol MgO}}\right) = 26.5 \text{ g MgO}$

Limiting Reagent: Mg

Theoretical Yield: 16.7 g MgO

$$\% \text{ yield} = \frac{\text{actual yield}}{\text{theo. yield}} \times 100$$

$$= \frac{11.9 \text{ g MgO}}{16.7 \text{ g MgO}} \times 100 = 71.3\%$$

⑥ (a) $58.80\ g\,C \left(\frac{1\ mol\ C}{12.01\ g\,C}\right) = 4.896\ mol\ C$

$9.87\ g\,H \left(\frac{1\ mol\ H}{1.01\ g\,H}\right) = 9.77\ mol\ H$

$31.33\ g\,O \left(\frac{1\ mol\ O}{16.00\ g\,O}\right) = 1.958\ mol\ O$

$\frac{C_{4.896}}{1.958}\ \frac{H_{9.77}}{1.958}\ \frac{O_{1.958}}{1.958} \Rightarrow (C_{2.5}\ H_{4.99}\ O) \times 2$

$C_5 H_{10} O_2$ ← Empirical Formula

$n = \frac{MM\ Molecule}{MM\ Emp.\ Form.} = \frac{102.13\ g/mol}{102.15\ g/mol} \approx 1$

Molecular Formula: $C_5H_{10}O_2$

(b) $8.59\ g\ CO_2 \left(\frac{1\ mol\ CO_2}{44.01\ g\ CO_2}\right)\left(\frac{1\ mol\ C}{1\ mol\ CO_2}\right)\left(\frac{12.01\ g\,C}{1\ mol\ C}\right) = 2.34\ g\,C$

$3.52\ g\ H_2O \left(\frac{1\ mol\ H_2O}{18.02\ g\ H_2O}\right)\left(\frac{2\ mol\ H}{1\ mol\ H_2O}\right)\left(\frac{1.01\ g\,H}{1\ mol\ H}\right) = 0.395\ g\,H$

mass $O = 4.30g\ sample - 2.34g\,C - 0.395g\,H = 1.565\ g\,O$

$2.34g\,C \left(\frac{1\ mol\ C}{12.01\ g\,C}\right) = 0.195\ mol\ C$

$0.395g\,H \left(\frac{1\ mol\ H}{1.01\ g\,H}\right) = 0.391\ mol\ H$

$1.565\ g\,O \left(\frac{1\ mol\ O}{16.00\ g\,O}\right) = 0.0978\ mol\ O$

$C_{\frac{0.195}{0.0978}} H_{\frac{0.391}{0.0978}} O_{\frac{0.0978}{0.0978}} \Rightarrow C_{1.99} H_{4.00} O$

C_2H_4O ← Empirical Formula

$n = \frac{\text{MM Molecule}}{\text{MM Emp. Form.}} = \frac{88.119 \text{ g/mol}}{44.06 \text{ g/mol}} = 2$

Molecular Formula: $(C_2H_4O) \times 2 \Rightarrow C_4H_8O_2$

(7) (a) $M = \frac{\text{mol solute}}{\text{L soln}}$ mol NaCl = M(L) = (0.0475M)(0.2500L)

= 0.0119 mol NaCl

grams NaCl = 0.0119 mol NaCl $\left(\frac{58.44 \text{ g NaCl}}{1 \text{ mol NaCl}}\right)$

= 0.694 g NaCl

(b) $C_1V_1 = C_2V_2$ $V_1 = \frac{C_2V_2}{C_1} = \frac{(0.500M)(0.450L)}{10.0M}$

= 0.0225L = 22.5mL of 10.0M HNO_3

(8) $2HCl_{(aq)} + Ba(OH)_{2(aq)} \rightarrow BaCl_{2(aq)} + 2H_2O_{(l)}$

(9) mol HCl = (0.150M HCl)(0.125mL) = 0.01875 mol = 0.0188 mol HCl

$0.0188 \text{ mol HCl}\left(\frac{1 \text{ mol } Ba(OH)_2}{2 \text{ mol HCl}}\right) = 9.38 \times 10^{-3} \text{ mol } Ba(OH)_2$

$L\ Ba(OH)_2 = \frac{9.38 \times 10^{-3} \text{ mol } Ba(OH)_2}{0.150M} = 0.0625L = 62.5mL$ of 0.150M $Ba(OH)_2$

(b) $0.0188 \text{ mol HCl} \left(\frac{1 \text{ mol } BaCl_2}{2 \text{ mol HCl}} \right) = 9.38 \times 10^{-3} \text{ mol } BaCl_2$

$$[BaCl_2] = \frac{9.38 \times 10^{-3} \text{ mol } BaCl_2}{0.188 \text{ L}} = 0.0500 \text{ M } BaCl_2$$

↖ total volume = 125 mL + 62.5 mL = 187.5 mL